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# THE FLASH PROGRAMMER MODEL TFP3

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*User's Guide*  
*March 2015*

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Rev. 2.2, March 2015

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# 1 Introduction

The TFP3 (The Flash Programmer 3) is a multipurpose programmer from Maxim Integrated used to perform flash utility operations on Maxim energy metering SOCs. The available versions of the TFP3 are listed in *Table 1*.

*Table 1: TFP3 Versions*

ID	Function	Ordering Part Number
TFP3-8051	Flash Programmer for 8051-based Metering Devices. With Security <sup>(1)</sup>	80515-FPBM-TFP3
TFP3L-MAXQ30	Flash Programmer for ZON™ Family Metering Devices (MAXQ®-based). No Security	MAXQ30-FPBM-TFP3L#
TFP3Q-MAXQ30	Flash Programmer for ZON™ Family Metering Devices (MAXQ-based). With Security <sup>(1)</sup>	MAXQ30-FPBM-TFP3Q#

*(1) With the security feature, the programming content is stored, programmed, and verified using AES 128-bit security.*

This user's guide documents how to connect, set up, initialize, and perform flash utility operations and firmware upgrades using the TFP3. It also provides a detailed explanation of supported commands and insight into the various features of the TFP3 models with and without security features.

## 1.1 TFP3 Overview

The TFP3 is used to perform flash utility operations on Maxim Integrated's energy metering SoCs. The TFP3 has three operating modes:

- stand-alone
- host
- ATE

In the Stand-Alone mode, the TFP3 is used to program and verify the DUT. By pressing the pushbutton switch, the DUT is programmed with and verified against the preloaded flash programming file.

The Host mode is used to send and receive commands to/from the TFP3 using a GUI or CLI application, running on a Windows PC, via USB interface. In addition to performing flash utility operations, Host mode is also used to get diagnostic information and upgrade the programming file on the TFP3.

ATE mode is used for factory automation using the TFP3. Using this mode, the TFP3 can program and verify without using any host applications. The external ATE hardware, connected to the TFP3, drives the ATE signals to perform a program and verify operation of the DUT firmware.

TFP3 has internal flash memory, which can store a maximum 512KB file size of DUT firmware. The secure models of TFP3 also provide a high level of security to the DUT firmware by supporting features like AES key matching and data encryption/decryption using AES hardware. A USB interface is used to power up the TFP3 device and for communication with the host. The TFP3 can power the DUT at 3.3VDC with up to 300mA.

*MAXQ is a registered trademark and ZON is a trademark of Maxim Integrated Products, Inc.*

There are two variants of TFP3 devices available in the market:

- The TFP3 secure model is used for performing flash utility operations securely via a hardware AES encryption in ECB mode and decryption mechanism to protect the DUT's IP and also to restrict access to the device to authorized users.
- The TFP3 non-secure model does not use any security mechanism and allows the user much easier access to download and flash utility operations.



Figure 1: Secure TFP3 8051 Device Model Number TFP3-8051



Figure 2: Secure TFP3 MAXQ30 Device Model Number TFP3Q-MAXQ30



Figure 3: Non-Secure TFP3 MAXQ30 Device Model Number TFP3L-MAXQ30

## 1.2 TFP3 Features

The TFP3 is a multipurpose flash programming device with the features listed below. Each feature is explained in detail in the following chapters.

- Programming of the TFP3 internal flash memory
- Pushbutton programming of the DUT via CC51 or JTAG Interface
- Host application-based programming of DUT via CC51 or JTAG Interface
- ATE-based programming of DUT via CC51 or JTAG Interface
- TFP3 diagnostic info access
- Secure dumping of the DUT code image to the host
- TFP3 GUI operation
- Generation and loading of the package file
- TFP3 parameter preservation
- Downloading of the DUT hex file to the TFP3
- TFP3 firmware upgrade using in-application programming

## 1.3 Safety and ESD Notes

Standard ESD handling precautions should be employed whenever handling electronic equipment. The TFP3 Flash Programmer utilizes ESD protection devices on its cable interfaces. Potential equipment damage and/or malfunction are possible if work-surface grounding procedures are not incorporated.



TFP3 ESD protection devices do not protect the target's hardware (DUT). Also, if the TFP3 device is connected to a target while the target is being powered using AC mains, then the ICE port and the ATE port are now high voltage. Correct handling procedures and proper work area grounding minimizes damage to all equipment!

## 1.4 TFP3 Kit Contents

- TFP3 Device
- FC-10 cable for CC51 or JTAG connection, 20-25cm in length
- USB A-to-B cable to connect the TFP3 to the host (PC) or to a USB 5V DC adapter (not provided with the kit)
- CD-ROM containing:
  - TFP3 Windows installation executable (TFP3 XX-YY.exe) with Microsoft .NET 4.0 packaged for TFP3 GUI and CLI application software
  - TFP3 Host USB CDC driver
  - TFP3 User's Guide
  - TFP3 Quick Start Guide



## 1.5 System Requirements

The TFP3 operating in host mode requires a Windows PC with the following features:

- 1 GHz processor and 1 GB RAM
- Minimum 1024 x 768 video display resolution
- Available USB port
- Microsoft Windows® 7 or Windows XP

*Windows is a registered trademark of Microsoft Corp.*

## 2 Getting Started

This section provides details on connections, setup, and initialization procedures of the TFP3 device.

**Note:** In the following sections, software-related items are identified by bolding. **Text in bold** refers to items directly from the EV Kit software. **Text in bold and underlined** refers to items from the Microsoft Windows operating system.

### 2.1 Connections to the Host and Setup

The TFP3 connects to a host PC with a USB A-to-B cable, and the cable provides both data and power (no external supplies are needed). *Figure 4* shows the basic connection diagrams for the TFP3 for programming ZON (MAXQ30-based) and 71M65xx (8051-based) parts. It is possible to operate the TFP3 in both stand-alone (only target and TFP3) and PC-connected configurations. For stand-alone configurations, the TFP3 has to be powered via the USB connector.

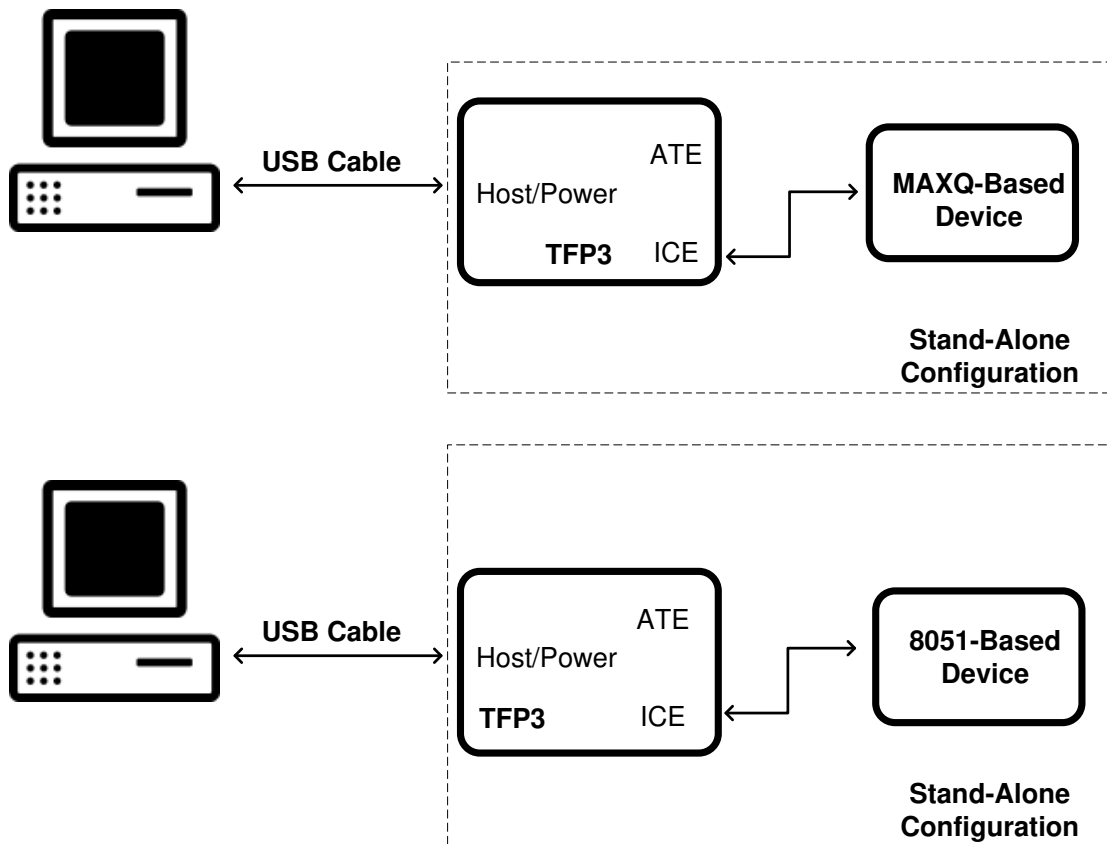


Figure 4: TFP3 Typical Connection Diagram

## 2.2 TFP3 Connection to the Host

The following steps are required to connect the TFP3 to the host successfully. Follow these steps before starting any communication with the TFP3 from the host.

1. Connect USB A-to-B cable between the host and the TFP3 device.
2. When the TFP3 is connected to the host, the status LED should be red first and turn to green continuously for the TFP3-8051 model. For other models of the TFP3, the LED is continuously green when connected to the host.
3. When the notification window with the text, "Installing device driver software," appears on the PC screen, go to **Start > Control Panel > Device Manager > Other Devices**. Right-click on "**MAXQ CDC-ACM Demo**," and update the driver software by pointing to the "**Oem54.inf**" file on the CD-ROM included in the TFP3 Programmer's Kit.



Figure 5: Device Manager

4. When the TFP3 Host driver software installation is successful, the TFP3 device is enumerated as a COM port, as shown in Figure 6.

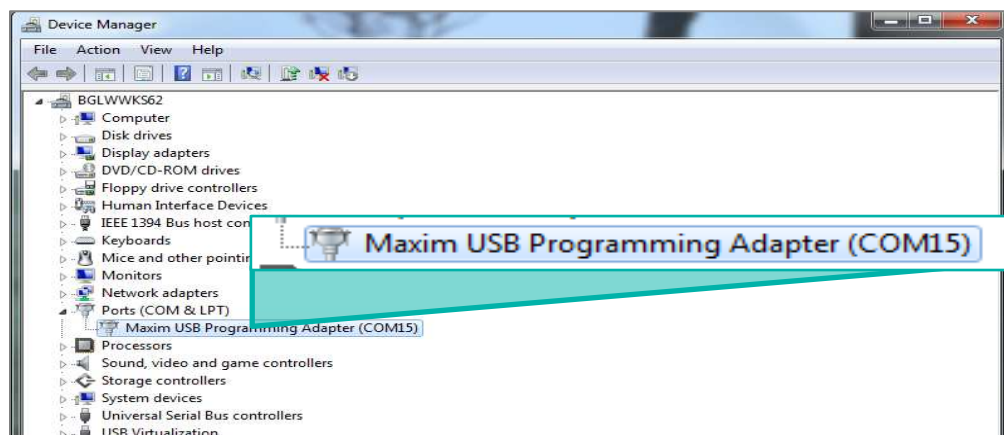


Figure 6: COM Port Enumeration

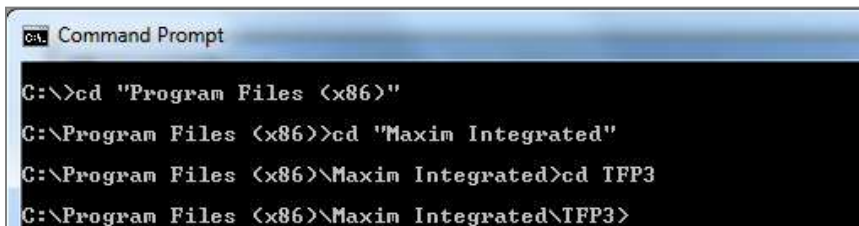
## 2.3 Using the TFP3 in Host Mode

The Host mode is used to get diagnostic information and upgrade the programming file on the TFP3. Once the TFP3 device is connected, powered on, and enumerated as a COM port, the user can start sending commands and receiving responses from the TFP3 in host mode using a command-line interface utility (TFP3.exe) or GUI application.

### 2.3.1 Procedure to Communicate with the TFP3 Device via TFP3.EXE

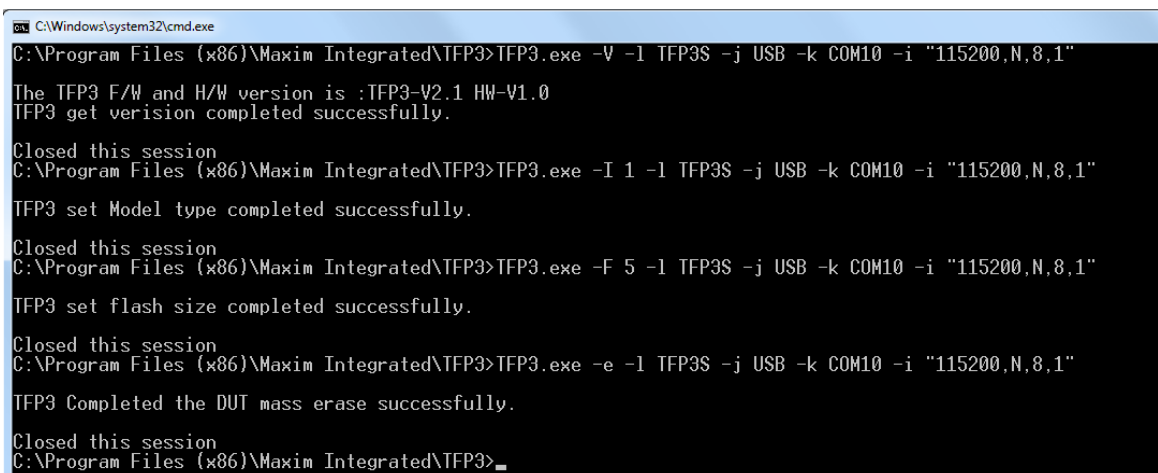
1. Open the Windows command prompt on the PC (**Start > Run > cmd**).
2. Enter the command `cd xxxx`, where "xxxx" is the path to where the TFP3.exe file is saved.
3. Execute the required commands using the TFP3.exe console.

The steps in the figures below detail the commands to get the version of the TFP3, set model type, set flash size of the DUT, and master erase the flash of the DUT.



```
ca. Command Prompt
C:\>cd "Program Files (x86)"
C:\Program Files (x86)>cd "Maxim Integrated"
C:\Program Files (x86)\Maxim Integrated>cd TFP3
C:\Program Files (x86)\Maxim Integrated\TFP3>
```

Figure 7: Navigating the Path to the TFP3.EXE



```
ca. C:\Windows\system32\cmd.exe
C:\Program Files (x86)\Maxim Integrated\TFP3>TFP3.exe -V -I TFP3S -j USB -k COM10 -i "115200,N,8,1"
The TFP3 F/W and H/W version is :TFP3-V2.1 HW-V1.0
TFP3 get version completed successfully.
Closed this session
C:\Program Files (x86)\Maxim Integrated\TFP3>TFP3.exe -I 1 -I TFP3S -j USB -k COM10 -i "115200,N,8,1"
TFP3 set Model type completed successfully.
Closed this session
C:\Program Files (x86)\Maxim Integrated\TFP3>TFP3.exe -F 5 -I TFP3S -j USB -k COM10 -i "115200,N,8,1"
TFP3 set flash size completed successfully.
Closed this session
C:\Program Files (x86)\Maxim Integrated\TFP3>TFP3.exe -e -I TFP3S -j USB -k COM10 -i "115200,N,8,1"
TFP3 Completed the DUT mass erase successfully.
Closed this session
C:\Program Files (x86)\Maxim Integrated\TFP3>
```

Figure 8: Executing TFP3 Secure Model Commands Using the TFP3.EXE

```

C:\Windows\system32\cmd.exe
C:\Program Files (x86)\Maxim Integrated\TFP3>TFP3.exe -V -l TFP3US -j USB -k COM10 -i "115200,N,8,1"
The TFP3 F/W and H/W version is :TFP3-V2.1 HW-V1.0
TFP3 get verision completed successfully.

Closed this session
C:\Program Files (x86)\Maxim Integrated\TFP3>TFP3.exe -I 2 -l TFP3US -j USB -k COM10 -i "115200,N,8,1"
TFP3 set Model type completed successfully.

Closed this session
C:\Program Files (x86)\Maxim Integrated\TFP3>TFP3.exe -F 5 -l TFP3US -j USB -k COM10 -i "115200,N,8,1"
TFP3 set flash size completed successfully.

Closed this session
C:\Program Files (x86)\Maxim Integrated\TFP3>TFP3.exe -e -l TFP3US -j USB -k COM10 -i "115200,N,8,1"
TFP3 Completed the DUT mass erase successfully.

Closed this session
C:\Program Files (x86)\Maxim Integrated\TFP3>

```

Figure 9: Executing TFP3 Non-Secure Model Commands Using the TFP3.EXE

For details of the commands supported by the TFP3, see **Chapter 5: Supported Commands** or the sample commands document provided in the TFP3 GUI installation folder for examples of usage with the host application.



**TFP3 Host Mode communication should not be performed until the TFP3 enumerates as a COM port.**

### 2.3.2 Procedure to Communicate with the TFP3 Device via TFP3GUI.EXE

1. Open the TFP3 GUI on the PC by clicking on **Start > All Programs > Maxim Integrated > TFP3 > TFP3GUI.EXE**.
2. Select the Model type through which the DUT communication is achieved from **Select Model Type** drop-down menu.
3. Select the DUT flash size connected to the TFP3 from **Select DUT Flash Size** drop-down menu.
4. The TFP3 GUI will auto-detect the TFP3 device and connect to it.

To manually configure and connect to the TFP3:

- a. On the **Options** menu, select **Configure serial port**, and choose the correct serial port number.
- b. On the **Target** menu, select **Connect to TFP3 device** to connect with the TFP3 device from the Host.
5. Send the required commands to the TFP3 device by selecting from the four command groups listed under the **File** menu.

For more details on using the TFP3 GUI, click on the application's **Help** menu, and select **Contents and Index**.

## 2.4 TFP3 Secure Model Initialization

The TFP3 needs to be initialized with the following commands before performing any other operations. This sequence is necessary to ensure that the DUT firmware is securely updated or verified.

1. Execute the **Modify AES keys** command (**K**) to modify the AES 128-bit keys in the TFP3.
2. Execute the **Select Model Type** command (**I**) to identify which type of TFP3 is used for DUT communication.
3. Execute the **Set Flash Size** command (**F**) to identify which type of target is connected to TFP3.
4. *(Optional)* Execute the **Set DUT Serial Number Count** command (**K**) to set the unique serial number of the DUT connected to TFP3. This command is required to send to the TFP3 device only if the parameter preservation feature is required by the user.
5. Execute the **Set TFP3 JTAG Clock** command (**J**) to set the clock by which the DUT communicates with the TFP3. Supported by the TFP3Q-MAXQ30 Model.

## 2.5 TFP3 Non-Secure Model Initialization

The TFP3 non-secure model needs to be initialized with the following commands before performing any other operations. This sequence is necessary to ensure that the DUT firmware is updated or verified properly.

1. Execute the **Select Model type** command (**I**) to identify which type of TFP3 is used for DUT communication.
2. Execute the **Set Flash Size** command (**F**) to identify which type of target is connected to the TFP3.
3. Execute the **Set TFP3 JTAG Clock** command (**J**) to set the clock by which the DUT communicates with the TFP3. Supported by the TFP3L-MAXQ30 Model.
4. Execute the **Set TFP3 Programming Count** command (**m**) to set the maximum number of times the TFP3 can perform the program and verify operation.

## 3 Features

### 3.1 Programming the TFP3 Internal Flash Memory

The TFP3 Programmer allows programming devices with a flash size up to 512KB. The DUT firmware is downloaded to the TFP3 using the USB interface and host application software. On the TFP3 secure model, the DUT firmware is AES ECB encrypted before storing it in the TFP3 internal memory. This ensures that the DUT firmware is protected from unauthorized access.



**Setting the wrong model type and flash size values in the TFP3 will result in incorrect data being programmed in the DUT.**

#### 3.1.1 Steps for Programming the TFP3 Internal Flash Memory

1. Execute **Set Model Type** command (**I**) to set the model type of the TFP3 connected to the DUT.
2. Execute **Set Flash Size** command (**F**) to set the flash size of the connected DUT.
3. Execute **Generate Package File** command (**g**) to create a package file for the TFP3 Secure model.
4. Execute **Load Package File** command (**H**) to send it to the TFP3 device (TFP3 secure model).

For the TFP3 non-secure model, execute the **Load Hex File** command (**H**) to send the DUT hex file to the TFP3 device.

For details of the commands supported by the TFP3, see *Chapter 5: Supported Commands* or the sample commands document provided in the TFP3 GUI installation folder for examples of commands that can be used with the host application.

## 3.2 Stand-Alone/Pushbutton Programming

This mode is used to perform only the DUT program and verify operation. This mode does not use host application software. A pushbutton switch on the TFP3 front panel is used to start this operation. The TFP3 indicates the USB enumeration failed by toggling the status LED between green and red and sounding a buzzer five times (300ms apart).

### 3.2.1 Steps for Performing Pushbutton Programming

1. Connect the DUT to the TFP3 using an FC-10 Flat interface cable.
2. Connect the TFP3 to the DC adapter using a USB A-to-B cable. This step is required to power on the TFP3.
3. The status LED will toggle from red to green and the buzzer will sound five times (300ms apart) to indicate that the TFP3 USB enumeration failed.
4. Press the red pushbutton switch for 300ms, and then release it to start the program and verify operation of the DUT firmware.

The status LED will toggle from red to green until the program and verify operation is complete.

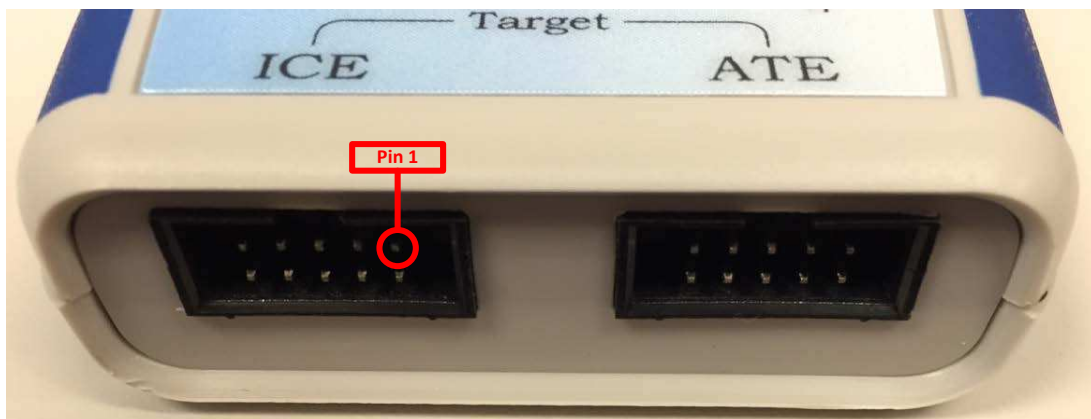
If the TFP3 completes the program and verify operation successfully, the status LED turns green to indicate the programming and verification of the DUT flash memory is successful.

If the TFP3 does not complete the program and verify operation successfully, the status LED remains red and the buzzer will sound 3 times to indicate the failure.

## 3.3 ICE Port

The ICE port is used for DUT programming. The standard CC51 (TFP3-8051) and JTAG interface (TFP3L-MAXQ30, TFP3Q-MAXQ30) define the ICE port signals function TFP3.

**Note:** The cable port connected to the TFP3 device has pin 1 on the top left as shown above. Also, there is a notch on this connector, so it can only plug into the TFP3 device in one direction.





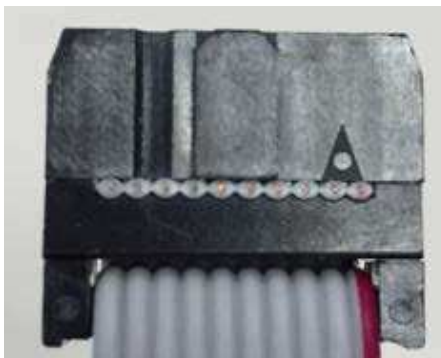
*Table 2* and *Table 3* describe the pin assignment on the cable port connected to the DUT for the various TFP3 models.

**Note:** The side of the connector where Pin 1 is located is marked with a triangle.

*Table 2: ICE Connector to JTAG Cable (2x5) for TFP3Q-MAXQ30 and TFP3L-MAXQ30*

Pin Number	Signal	Function
1	ICE_E	Enables the programming interface when high
2	GND	Ground, return
3	E_RST	Emulator reset
4	VCC	Supply Power (+3.3VDC at 300mA, max)
5	E_TCLK	Emulator clock
6	TMUX	Optional signal. Not required for programming.
7	N/C	Not connected
8	N/C	Not Connected. (+5VDC for TFP3L-MAXQ30)
9	E_RXTX	Emulator data (RX and TX), bidirectional
10	GND	Ground, return

**Note:** If pin 4 in *Table 2* is used to power the target, then a 1000 $\mu$ F/10V capacitor should be placed in between VCC and GND of the DUT board in order to prevent the TFP3 device from resetting due to the inrush current.



To ZON Device (2x5 cable)

*Table 3: ICE Connector to ICE Cable (7x1)*

Pin Number	Signal	Function
1	TMUX	Optional Signal
2	ICE_E	Enables the programming interface when high
3	GND – RETURN	Ground, return
4	E_RST	Emulator reset
5	E_TCLK	Emulator clock
6	E_RXTX	Emulator data (RX and TX), bidirectional
7	VCC	Supply power (+3.3VDC)

**Note:** Even though the TFP3 can supply power to the target, many target boards (e.g. 71M653x, 71M652x) assign V3P3D to the pin corresponding to pin 7 in *Table 3*. This means that the target boards still need to be powered with a separate DC supply. If pin 7 is used to power the target, then a 1000 $\mu$ F/10V capacitor should be placed in between VCC and GND of the target board in order to prevent the TFP3 device from resetting due to the inrush current.



To 8051 Device (7x1 cable)

### 3.4 ATE Programming

This mode is used to automate the programming or verification of DUT firmware using the TFP3 and external ATE hardware. ATE hardware drives the ATE signals as per TFP3 requirements to perform the program and verification operation. Other operations are not supported in this mode. This section describes the ATE programming setup and software algorithm to be implemented by the ATE. *Figure 10* and *Table 4* detail the ATE interface signals and descriptions.

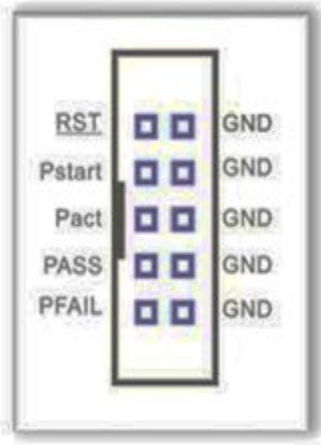


Figure 10: ATE Connector Pin Locations

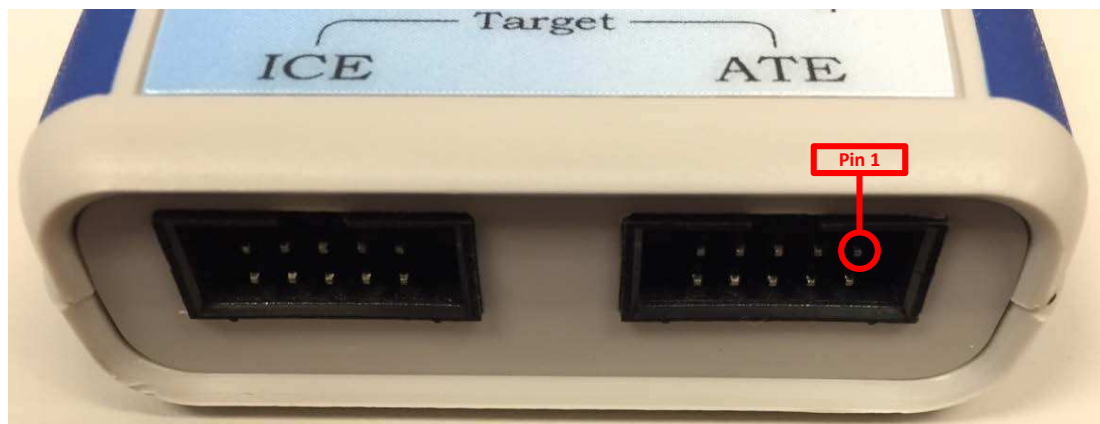


Table 4: ATE Connector Pin Descriptions

ATE Connector Pin	Pin Function	TFP3 I/O	Description
1	ATE Reset	Input	Active Low Reset to TFP3 Hardware
2	GND	–	Ground
3	ATE Program Start	Input	Active High Signal Starts Target Flash Memory Programming. A minimum of 500ms pulse is required.
4	GND	–	Ground
5	ATE Program Active	Output	Active High Signal Indicates Target Flash Memory Programming in Progress. De-assert ATE program start upon ATE Program Active going high.
6	GND	–	Ground
7	ATE Pass	Output	ATE Pass Active High Signal Indicates Target Flash Memory Programmed and verified Target Microcontroller to be Correct. ATE Pass goes low when ATE Program Start reasserted high.
8	GND	–	Ground
9	ATE Fail	Output	ATE Fail Active High Signal Indicates Target Flash Memory Failed Programming and Verification of Target Microcontroller. ATE Fail goes low when ATE Program Start is reasserted high.
10	GND	–	Ground

### 3.4.1 Steps for ATE Programming

1. Connect external ATE hardware to the TFP3 ATE connector using a custom cable.
2. Power ON the external ATE hardware.
3. Connect the TFP3 to the DC adapter using a USB A-to-B cable. This step is required to power on the TFP3 and DUT.
4. The status LED will toggle from red to green and the buzzer will sound five times (300ms apart) to indicate that the TFP3 USB enumeration failed.

The TFP3 is now ready to perform ATE communication. The user can drive the ATE signals using any external ATE equipment in a factory production environment.

### 3.4.2 Flash Sizes of Energy Metering Microcontrollers

Table 5: Maximum Flash Sizes of Different Energy Metering Microcontrollers

Microcontroller	Max Flash Size (KB)
71M6513/6513H	64
71M6521BE, 71M6521DE, 71M6521FE	8, 16, 32
71M6531, 71M6531E	128, 256
71M6533D/6533DH, 71M6533F/6533FH	128, 256
71M6534	128
71M6534H	256
71M6545, 71M6545H	32, 64
71M6542F/H	64
71M6543G/GH	128
71M6542F	64
71M6541D, 71M6541F	32, 64
71M6532D, 71M6532F	128, 256
71M6534, 71M6534H	128, 256
MAX71313L, MAX71314L	64, 128
MAX71314, MAX71315	128, 256
MAX71334L, MAX71335L	128, 256
MAX71335S, MAX71336S	256, 512

### 3.4.3 ATE Programming Sequence

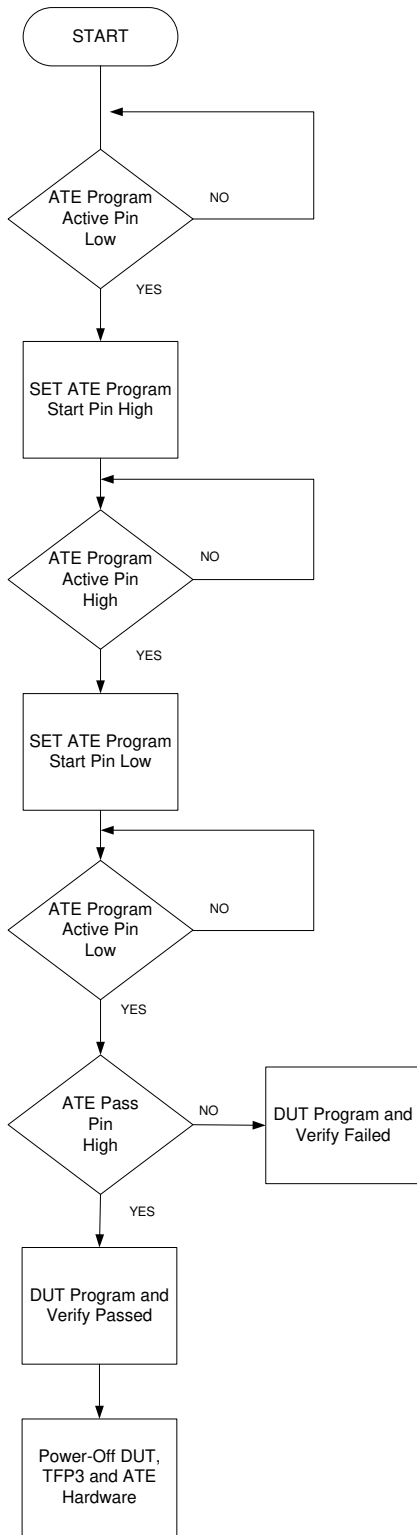


Figure 11: ATE Programming Sequence Flowchart

## 3.5 TFP3 Diagnosis Information Access

This feature is used to configure the TFP3 to restrict program and verify operations to a predefined number. This configuration can be set or reset by user commands. The TFP3 maintains the following parameters to keep the count of program and verify success/failed operations.

TFP3 provides the following diagnostic information:

1. Programming count
2. Total Pass count
3. Total Fail count

The default value of the Programming count is 1000000 (1 million). The Total Pass and Total Fail count default values are 0x00.

### 3.5.1 Programming Counts

The Programming count is a 4-byte value stored in the TFP3 EEPROM. The user has the flexibility to set this count value anywhere from 0 to 1000000 (1 million) on the TFP3 device. Once set, this count gets decremented by a value of 1 for every successful program and verify operation.

The Programming count value in the TFP3 decrements down to value 0. Once it reaches zero, the TFP3 device will not allow the user to perform any program and verify operation.

### 3.5.2 Total Pass Counts

The Total Pass count is a 4-byte value stored in the TFP3 EEPROM. The default value of this program count is set to 0x00. Whenever a program and verify operation is executed successfully by the TFP3 device, the Total Pass count value is incremented by 1.

### 3.5.3 Total Fail Counts

Total Fail count is a 4-byte value stored in the TFP3 EEPROM. The default value of this program count is set to 0x00. Whenever a program and verify operation is executed unsuccessfully by the TFP3 device, the Total Fail count value is incremented by 1.

## 3.6 Secured Dumping of Target Code to Host

This feature is only available in TFP3 Secure model, which is used to dump DUT firmware securely onto the host. This is achieved through the **Dump DUT Code** command (**D**). The TFP3 device sends the encrypted DUT code to the host in response to the command. The host runs the software AES 128-bit algorithm and decrypts it using the AES key provided during command execution, and then stores the data in a hex file format.

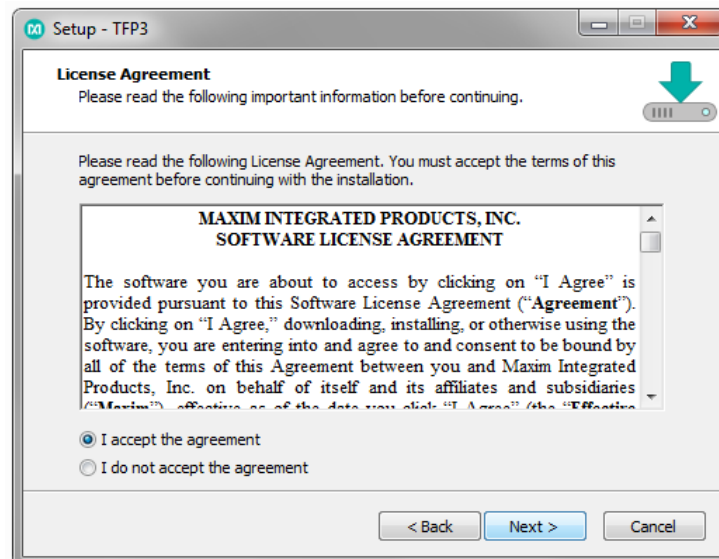
## 3.7 TFP3 GUI Operation

After the TFP3 is connected, powered on, and enumerated as a COM port, the user can start sending commands and receive responses from the TFP3 in host mode using the TFP3 GUI application. Listed below are the steps to install and start communicating with the TFP3 device using the TFP3 GUI application.

1. Run the TFP3 installation executable, **TFP3 XX-YY.EXE**, to start the installation process. (XX is the major version, and YY is the minor version.)

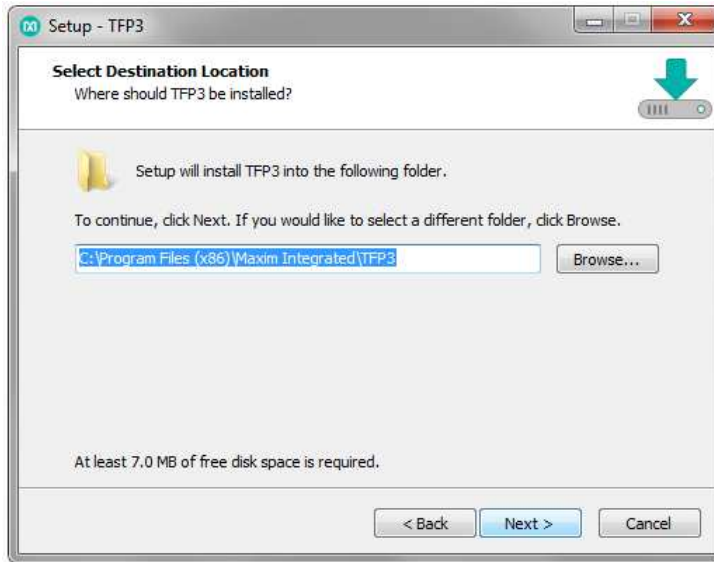


2. Accept the license agreement of TFP3 GUI to proceed with the installation process.

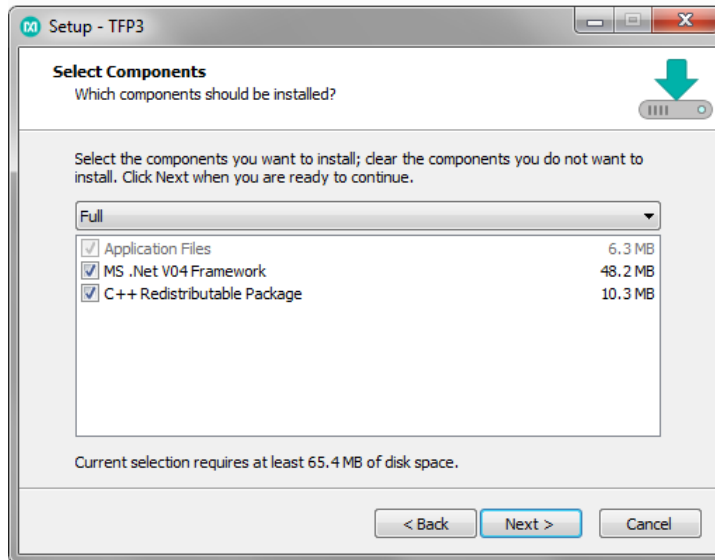




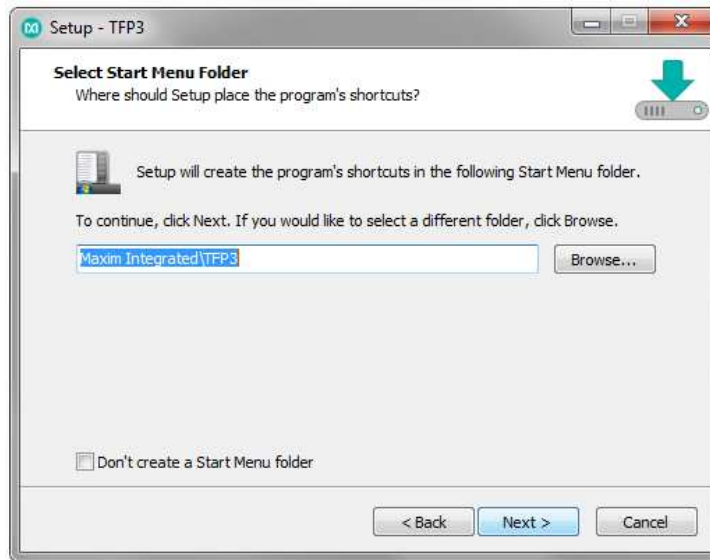
3. Provide the path to the directory in which to install the TFP3 GUI.



4. Select the components to install.



5. Provide the directory path for the Start Menu folder.



6. Select additional options.

